MALCOLM PIRNIE

# Technical Memorandum

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Date: September 9, 2009

To: Katherine Antos, EPA Chesapeake Bay Program Office

From: Clifton F. Bell, Malcolm Pirnie, Inc.

Re: Preliminary Comments on EPA-CBPO's "Analysis to Support Critical Period Selection" (9/9/09)

On behalf of the Virginia and Maryland Associations of Municipal Wastewater Agencies (V/MAMWA), Malcolm Pirnie is presenting these preliminary comments on the EPA-CBPO presentation entitled "Analysis to Support Critical Period Selection", which was posted for the September 9, 2009 teleconference of the Water Quality Goal Implementation Team. We appreciate the CBPO's investigation into the critical period question, and submit these comments to facilitate discussion of the topic during the teleconference.

Our preliminary review indicates that the CBPO's analysis has significantly underestimated the return period of the 1996-98 hydrology that would control Baywide allocations. Detailed comments are as follows:

1. *The CBPO's hydrologic analysis used a truncated period of record,which caused underestimation of return periods of extreme hydrology*. V/MAMWA's original hydrologic analysis used the 1968-2009 period, and used flow data for the Susquehanna and Potomac River basins only. In an effort to use data from more basins, the CBPO reduced the data analysis period to 1978-2009, losing significant information. As shown on slide 9 of the presentation, the addition of flow data from the additional seven basins brought almost no additional information to the analysis, because the effectiveness-weighted inflows are dominated by the Susquehanna and Potomac River inflows. Yet the loss of a decade worth of hydrologic information resulted in a significantly smaller "n" for calculation of return periods, which in turn caused the return periods to be underestimated.

Even use of the larger 1968-2009 period could cause underestimation of the return period, relative to using of the full streamflow record for the Susquehanna and Potomac Rivers. For example, a preliminary analysis using 1930-2009 streamflow data indicates the following:

- Using average January-May flows, 1996-98 has a return period of **78** years.
- Using the average September-June flows, 1996-98 has a return period of **26** years.

V/MAMWA will provide the results of this 1930-2009 results to the Bay Program for consideration.

2. *The use of September-June flows merits additional scrutiny, given the abundance of Bay literature on the importance of the winter-spring freshet*. V/MAMWA originally chose the January-May period based on an abundance of Bay-related scientific literature that either explicitly used this period in statistical modeling of Bay hypoxia (*e.g.*, Hagy and others, 2004; Scavia and others, 2006; Stow and Scavia, 2008) or otherwise emphasized the importance of the winter-spring freshet in not just delivering loads but also strengthening stratification and setting a starting point for D.O. decline (*e.g.*, Seliger and Boggs, 1988; Boicourt, 1992). Therefore, we found it interesting that the CBPO's analysis indicates that much longer monthly spans have stronger correlations with DO violation rates. Although this conclusion may be correct, we believe it merits additional scrutiny in light of previous literature findings.

As mentioned in comment #1, even if the September-June flows were used to characterize hydrologic conditions, the 1996-98 period appears to have a return interval of more than 25 years.

3. *The use of a "water quality" return period is problematic, but regardless, the "water quality" return period associated with the 1996-98 period has been underestimated*. The use of a "water quality" return period to define critical conditions is problematic both due to lack of precedent and the inappropriate combination of controllable and non-controllable factors. Critical conditions for almost all TMDLs in Bay states have been defined in terms of seasonal and/or hydrologic conditions. Critical conditions are generally intended to represent natural, non-controllable variability. A water quality return period, in contrast, is affected by many controllable factors including both nutrient loading and fisheries management. Importantly, the water quality return period is not independent of the TMDL itself, but would change as a function of the stringency of load allocations and fisheries management actions.

Regardless, even if one accepted the concept of using a water quality return period to set critical conditions, the return period of the 1996-98 period is underestimated at 10.5 years. The period of record for this analysis (1985-2006?) was even shorter than that used for the hydrologic analysis, due to lack of data prior to the mid-1980s. Although the D.O. violation rates of previous decades cannot be quantified, they are certain to have been generally lower than the 1985-2006 period. For example, it is generally believed that nutrient loads to the Bay have increased 2-3 times since 1950 (Hagy and others, 2004). Thus, the relatively moderate 10.5-year return period calculated for 1996-1998 is primarily a function of the limited data set available, rather than a true presentation of the return period.

**REFERENCES**

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Scavia, D., E.A. Kelly, and J. D. Hagy III. 2006 A simple model for forecasting the effects of nitrogen loads on Chesapeake Bay hypoxia . Estuaries and Coasts 29(4) 674-684.

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